Gamification in Citizen Cyberscience: Projects in Particle Physics and Synthetic Biology

Conference or Workshop Item

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ABSTRACT
We present two new citizen cyberscience projects that are being developed in the research fields of Particle Physics and Synthetic Biology, and discuss several issues to be considered in relation to the gamification of these projects.

Author Keywords
Citizen Science; Gamification; Games; Motivation; Engagement; Particle Physics; Synthetic Biology.

ACM Classification Keywords
H.1.2. User/Machine Systems: Human Factors.

General Terms
Human Factors.

INTRODUCTION

In citizen cyberscience, professional scientists collaborate with volunteers (citizens) to conduct scientific research via the Internet [5]. Scientists are increasingly using 'gamification' – the use of game design elements in non-game contexts [3] - to increase the appeal of their projects and to make them more engaging for volunteers, e.g. Foldit [2], Happy Moths [9] and Biotracker [1]. In this poster we present two new projects that are being developed in the research fields of Particle Physics and Synthetic Biology. We discuss several issues that are important to consider in the gamification of these projects (and citizen cyberscience projects in general).

THE PROJECTS

Particle Physics

The Particle Physics (PP) project is being developed by CERN. In a previous project [10] they used the power of the crowd (volunteer computing) to run high energy simulations [7]. Forum feedback revealed that volunteers were excited by the project and wanted to find out more about how the data was used. The PP project will allow volunteers to interact with the simulations directly. They will be asked to 'tune' the simulation (by modifying the parameters of the theoretical model) to give an optimal description of a chosen set of experimental reference data. In the process, they will learn about what the theory parameters mean (e.g. the first parameter represents the strength of the strong nuclear force). They will also learn about the types of experiments and measurements that have been carried out at a range of hi-tech facilities across the globe, such as the Large Hadron Collider (LHC) at CERN (Fig 1). The ultimate aim is for the volunteers to find new optimal solutions that improve upon the existing 'tunes'.

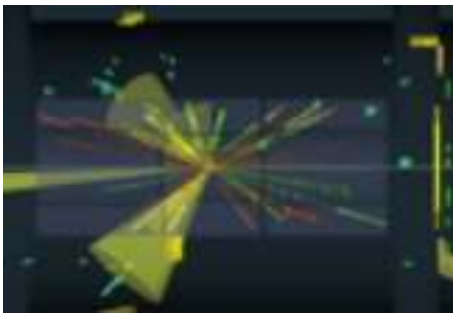

Figure 1. ATLAS Experiment © 2013 CERN

Game design elements: There will be a leaderboard showing the optimal tunes. There will be the option for players to work in teams. They will also be able to comment and rate all content, including each other's simulation descriptions.

Synthetic Biology

The Synthetic Biology (SB) project is being developed by UPD. They are hoping to engage more young people by building a game that teaches some the central SB concepts and encourages scientific creativity. The player must help a bacterium character (Fig. 2) to overcome obstacles and challenges in the environment; and through doing so they will learn how SB allows you to modify, design and control the behavior of an organism, in order to perform useful and predictable functions. For example, you might want to modify the bacteria so that it can shine in the dark, or sense and respond to specific molecules.

Currently the game runs a simulator that allows the player to experiment with a flexible and realistic crafting system

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of biological devices, based on the combination of Biobricks. In the future it is hoped that advanced levels of the game could be complex enough to lead to players making new discoveries in the field of SB.

Figure 2. Synthetic Biology game © 2013 UPD

Game design elements: The player will control the bacteria similar to a 2D first-person adventure game (e.g. 'Zelda'). There will be several levels for the player to complete, where they will tackle (and learn) more difficult concepts as they progress.

ISSUES TO CONSIDER WHEN 'GAMIFYING'

There are several important issues to consider in relation to the development of both projects:

1. *'Game' is a loaded word.* The word 'game' might put off some volunteers, as they may view the project as 'less serious' [1, 8]. For the PP project, we are considering calling it a 'simulation' instead.
2. *Learning requires meaningful game mechanics.* In the SB project the key concepts for players to learn will be tightly embedded in the game play (learning by doing). In the PP project, volunteers will be asked to write explanations of their simulations and then can vote on which explanation is best (group learning).
3. *Leaderboards can demotivate as well as motivate.* Volunteers can feel demotivated if they think it is impossible to catch up with the person on top of the leaderboard [8]. In both projects, it will be important to ensure that all volunteers feel that their contributions are valued.
4. *Ensuring data quality.* A frequent concern is that gamifying a citizen science project could have an adverse effect on data quality [1, 9]. To deter volunteers from 'gaming' the system, the PP project plans to have a human evaluator (scientist) checking solutions that the system indicates as 'optimal' and deciding the ranking of players on the leaderboard.
5. *Encouraging sociability.* A sense of community is important for sustaining engagement [5, 6]. For both SB and PP projects, social tools (e.g. forums) will enable volunteers to communicate with each other. The PP project will also utilize team play.
6. *Recognition from scientists is the best reward.* Volunteers valued being able to interact with scientists [5, 6]. It is important that it is not just the game that rewards players, but that the scientists recognize volunteer contributions too, e.g. volunteers that discovered a new protein structure while playing Foldit were included as co-authors on research papers [2]. Similarly, the PP project plans to name the tune after the person that invented it, e.g. the Jeppsson tune [4].

FUTURE WORK

As development continues, formative evaluations will be conducted to ensure that the game elements are having the intended positive effects. Both projects will be launched to the general public by 2015.

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